ABSTRACTS
MOLLUSCAN EXTINCTIONS IN THE GEOLOGIC PAST AND THE PRESENT TIME

Arranged by Geerat J. Vermeij
University of Maryland

ON THE CRETACEOUS EXTINCTION OF THE AMMONITE CEPHALOPODS. Peter Ward, Department of Geology, University of California, Davis.

The ammonites were the most diverse group of cephalopods known from the fossil record. After a long evolutionary history, they underwent complete extinction at the end of the Cretaceous period. This extinction, however, was preceded by changes in shell morphology which can be interpreted to imply major habitat change, and possibly change in mode of life prior to the extinction event itself.

FAUNAL REPLACEMENT AND CAUSES OF POST-MIOCENE EXTINCTION OF PELECYPODS IN THE CHESAPEAKE BAY REGION OF MARYLAND. Brett W. Kent and **Geerat J. Vermeij,** Department of Zoology, University of Maryland, College Park.

Only 28 of 72 subgenera (39%) of epifaunal and sand- and mud-burrowing pelecypods present in latest Miocene time in the Chesapeake Bay region of Maryland are living today in shallow waters of the Virginian Province (Cape Cod to Cape Hatteras). There are 12 globally extinct taxa which appear to have been endemic to the Chesapeake region. Of the 32 subgenera which have become locally extinct, all are known south of Cape Hatteras, and only one has a broad distribution extending both north of Cape Cod and south of Cape Hatteras. The modern Virginian shallow-water fauna of epifaunal and burrowing bivalves consists of 55 subgenera, of which 27 (49%) are not known as fossils. Both among taxa not known as fossils and among taxa surviving from the Miocene, broad latitudinal distributions are common (22 subgenera, 40% of modern fauna), and a substantial number (12 taxa, 22%) is characterized by a northern distribution extending from within the Virginian Province to north of Cape Cod. These distributional data are consistent with those of Petuch (1983) for gastropods. They suggest strongly that the Late Miocene climate of Maryland was both warmer and less extreme in temperature range than it is today. Moreover, substantial immigration from the north has occurred, resulting in a partial faunal replacement and in a faunal mixture consisting of surviving local taxa with a southern or latitudinally broad distribution and of an introduced northern fraction. Stanley and Campbell's (1981) hypothesis that the chief cause of extinction in the Western Atlantic was a shift in climate is supported by our data from Maryland.

DIFFERENTIAL EXTINCTION IN TROPICAL AMERICAN MOLLUSCS: ENDEMISM, SHELL ARCHITECTURE, AND THE PANAMA LAND BRIDGE. Geerat J. Vermeij and **Edward J. Petuch,** Department of Zoology, University of Maryland, College Park.

The uplift of the Central American isthmus during the Pliocene triggered a substantial impoverishment in the biota of tropical America. We tabulated all Pliocene supraspecific taxa and their living descendants in 17 families and superfamilies of molluscs for each of three marine biogeographical regions: (1) the Caloosahatchian Province, centered in Florida; (2) the Atlantic Gatunian region, comprising the modern tropical Atlantic; and (3) the Pacific Gatunian region, corresponding to the modern tropical Eastern Pacific. Extinction affected gastropods to a greater extent in the Caloosahatchian (36%) and Atlantic Gatunian regions (36%) than in the Pacific Gatunian area (15%). In all regions, endemic taxa suffered more than 50% extinction. Because the Atlantic faunas were substantially richer in endemics than was the Eastern Pacific, part of the interoceanic difference in the impact of extinction is attributable to the high susceptibility of narrowly distributed taxa to extinction. Patterns of extinction in bivalves were similar to those in gastropods.

The tendency for hard-bottom gastropods to be somewhat more resistant to extinction than were soft-bottom taxa is shown to be partly the result of an artifact of geographical range, there being relatively few endemic taxa among hard-bottom gastropods. Hard-bottom taxa with a narrow or thick-lipped aperture were more susceptible to extinction in the Atlantic than were their wide-apertured counterparts. This pattern, which is not an artifact of geographical range, resulted in a post-Pliocene decline in the incidence of apertural protective devices among hard-bottom Atlantic gastropods while the incidence in the Eastern Pacific remained constant.

THE TAXONOMIC STRUCTURE OF SHALLOW-WATER MARINE FAUNAS: IMPLICATIONS FOR PHANEROZOIC EXTINCTIONS. David Jablonski, Department of Ecology and Evolutionary Biology and **Karl W. Flessa,** Department of Geosciences, University of Arizona, Tucson.

The taxonomic and biogeographic structure of Recent shallow-marine faunas provides a means of evaluating the causes and magnitudes of extinctions in the fossil record. We assembled data on the distribution of families of marine gastropods, bivalves, echinoderms, and scleractinian corals, and on the number of species within families in gastropod, bivalve, and echinoid faunas. The 22 oceanic islands for which we collected data harbor a very large proportion (87%) of the global, shallow-water marine fauna, and 78% of the families are on two or more of those islands. Even if eustatic lowering of sea level completely eliminated the continental shelf faunas (itself an unlikely prospect), oceanic islands would provide a safe haven for representatives of the great majority of today's shallow-marine benthic families; this indicates that the effects of areal reduction alone are insufficient to explain extensive familial extinction during the mass extinctions associated with regression.

Continental shelf bivalve and echinoid faunas have significantly more species per family than island bivalve and echinoid faunas (a proportion of 1.5:1 and 1.3:1, respectively), though gastropod faunas show no such difference. Gastropod faunas display persistently higher species-family ratios than bivalve faunas, and echinoid faunas have the lowest ratios of the three classes. Species-family ratios are diversity-dependent, so that island-continental and class-to-class differences in species-family ratios appear to be a consequence of differing species richness among the faunas and classes.

The fossil record suggests that species richness within clades may not be an adequate measure of resistance to mass extinction. Tropical clades appear to suffer disproportionately during times of mass extinction, and in general species-rich clades are not better represented among survivors than species-poor clades. The linkage between speciation and extinction rates generates species-rich but evolutionarily volatile clades. Species richness within clades may, however, contribute to a clade's resistance to background extinction. That different factors contribute to extinction-resistance during times of mass vs. background extinctions suggest that macroevolutionary processes during those times are qualitatively as well as quantitatively different.

AVIAN MOLLUSCIVORES MINISYMPOSIUM

Arranged by David R. Lindberg
University of California

DESIGNER LIMPETS AND THEIR AVIAN CONSUMERS. Fred Sorenson, Moss Landing Marine Laboratories, California.

The limpet *Collisella pelta* has different shapes and forms on different substrata. Movement between substrata results in color patterns that make them conspicuous to avian predators. Transitional forms show up in higher proportions in Black Oystercatcher (*Haematopus bachmani*) middens than in the surrounding environment.

INTERTIDAL COMMUNITY STRUCTURE IN CENTRAL AND SOUTHERN CALIFORNIA: THE INTERACTION BETWEEN HUMAN DISTURBANCE, BIRD PREDATION, AND LIMPET TERRITORALITY. David R. Lindberg, James A. Estes, and **Kenneth I. Warheit,** Center for Coastal Marine Studies, University of California at Santa Cruz.

The presence or absence of the territorial limpet *Lottia gigantea* determines species diversity and abundances in the high and mid intertidal zones. The abundance of *L. gigantea*, in turn, is determined by the abundance of oystercatchers and humans. Humans also determine the abundance of oystercatchers.

ABSTRACTS
SUPPORT SERVICES IN MALACOLOGY

A PROPOSED GENERALIZED MOLLUSCAN SHELL GROWTH MODEL: GASTROPOD MORPHOLOGY AND CONSTRUCTIONAL PATTERNS. Matthew J. James, Department of Paleontology, University of California, Berkeley.

The great diversity of molluscan shell form can be classified and analyzed using components of the proposed shell growth model. This is a descriptive model, not a mathematical model or computer simulation, and is therefore based on empirical observations. Using gastropods as examples of complex constructional patterns, the model aids identification of temporal and spatial components of alteration in shell structure, ornamentation, and architecture. Two principal modes of calcium carbonate manipulation (deposition and resorption) are modified by four fundamental factors: 1)